Industrial standards provide a common means of understanding and communicating performance. This article examines the rationale and applications of the Compressed Air & Gas Institute’s standards for determining the energy efficiency of low-pressure blower packages.

The Compressed Air & Gas Institute (CAGI) has championed the development of two new annexes to the performance standards of compressors: ISO 1217 for positive displacement packages (rotary vane, rotary lobe, rotary screw, etc.), and BL 5389 for dynamic machines (centrifugal, turbo, etc.). Positive displacement and dynamic blowers employ different technologies to deliver air. As such, each machine type requires test methods specific to the technology.

CAGI standard BL 5389 provides a new simplified approach for centrifugal machines. This includes multi-stage machines and single-stage, high-speed turbo blowers. The new test code for testing turbo blower efficiency takes into account all energy inputs used to provide useful air output. It provides a “wire-to-air” energy measurement of a turbo package and reports the kW needed to deliver a given volume flow rate of air at a given pressure. CAGI started by utilizing existing test standards for centrifugal compressors and adapted them for use with blowers. In many cases, blowers are actually simpler to measure than compressors.

Importantly, the results obtained from test methods described in BL 5389 and ISO 1217 can be compared against each other directly using BL 300 (Simplified Acceptance Test of Electric Driven Low Pressure Air Blower Packages), a new CAGI standard designed to enable the collection and presentation of comprehensive and consistent performance data independent of blower technology. Applying this standard, prospective blower buyers and their technical advisors can make reliable comparisons.

- BL300 allows comparisons between dynamic blower technology and dynamic blower technology.
- It facilitates comparisons between positive displacement blower technology and positive displacement blower technology.
- Significantly, it also provides guidance for comparing dynamic blower technology with positive displacement blower technology.

The Push for Better Standards

Rob Haseley, Manager of Test Engineering and Qualification for Ingersoll Rand and Chairman of the Standards Committee for CAGI, emphasized that the development of the BL 300 standard was driven by the use of low-pressure compressed air in wastewater applications.

“There was a need for a standard because wastewater treatment facilities can get rebates from utility companies, but there was no test methodology to prove out the efficiency,” Haseley explained. “Now the BL 300 standard gives customers and manufacturers a way to demonstrate the efficiency of the product that we didn’t have before. That’s important because the customer is buying a black box. What they care about is the power it takes and the amount of airflow it puts out. That’s the main feature of the standard, the test methodology to measure power in and flow out, and the new standard was developed to test the whole package, wire-to-air. Long term, I expect it will become part of an ISO standard for low-pressure blowers.”

Blowing Bubbles

The need for blower test standards arose with the increased cost of power and the attention to operating costs in a key process of wastewater treatment. Aerobic microorganisms, known as “bugs” in the wastewater field, feed on the waste in a biological reactor or a treatment
basin. A constant oxygen supply is required to keep the bugs thriving and productive. Increasingly, wastewater plants are introducing the required oxygen through fine bubble aeration via diffusers submerged in the wastewater.

Fine bubble aeration systems use high volumes of low-pressure air, typically supplied by blowers. Since the bubbles are small, they have a high surface area to volume ratio, providing an opportunity for most of the oxygen in the air stream to be transferred to the water before the bubbles pop at the surface.

As electricity to power the blowers is often the largest cost in operating a wastewater process, manufacturers of blower packages began to provide their own assessments of energy efficiency. Head-to-head comparisons of energy efficiency between different technologies were difficult to make with confidence, however, because inconsistencies in test methods that can create disparities in performance data.

An Impetus for Change from the Consortium for Energy Efficiency (CEE)

In 2010, CAGI members were approached by the Consortium for Energy Efficiency (CEE) to address the need for test standards for dynamic blower packages among the CEE membership. “CEE is a consortium of energy efficiency program administrators from across the USA and Canada that work together to achieve lasting and verifiable energy efficiency,” said Jess Burgess, Senior Program Manager at CEE. “Energy efficiency programs in many regions have goals to help their wastewater facility customers to reduce their energy costs and improve performance, and blowers typically offer the largest savings opportunity in a wastewater facility.”

According to Burgess, CEE members were interested in the energy savings claims that surrounded turbo blowers when they were new to the market six or seven years ago. “Based on CEE member experience,” Burgess explained, “turbo blowers offer the potential to reduce blower energy consumption by 20 percent or more, resulting in potentially thousands of dollars of energy savings each year. CEE did a technical review and quickly understood that the technology had outstripped the test procedures used for blowers at that time. It was necessary for each manufacturer to do some interpretation of the existing test procedure, which introduced opportunities to test in ways that could favor one’s own products. This fostered distrust in the marketplace, as many customers and their representatives felt they could not trust equipment performance claims. CEE members thought that was a negative thing because the technology was promising and the energy savings from these technologies were real. The credibility of energy performance claims and product information is significant to energy efficiency program administrators, so CEE reached out to blower manufacturers and to CAGI to show our industry’s support for a new set of energy test procedures to place turbo blower products and all blowers on a level playing field.”

Burgess emphasized that blower projects for wastewater treatment may have a 6- to 18-month timeframe with a significant investment of time and personnel, and energy efficiency program incentives from utilities may run into tens of thousands of dollars. Having more credible and higher quality test data for turbo blowers will enable efficiency programs to support blower projects with greater confidence and investment, and will allow energy performance to be a more significant factor in customer purchase decision-making.
Based on discussions with many organizations in the wastewater industry, we expect this standard is going to impact the way that many blowers are specified and purchased for wastewater treatment facilities,” Burgess said. “With credible energy information on front end, there is confidence that the installed system will realize true energy savings.”

Creating the new CAGI BL 5389 Blower Standard

A working group was formed within CAGI’s Blower Section, and members embarked on a standard development project that initially resulted in the release of the BL 5389 standard in 2013 as an interim step. BL 5389 was intended to eventually become an annex to ISO 5389, which provides an extremely detailed, complex procedure to test and rate turbo blowers. The CAGI standard provides a simplified, easily integrated, cost-effective, yet highly accurate wire-to-air approach to testing that is applicable to all dynamic blower packages in all industrial and municipal air applications.

BL 5389 specifies standardized test procedures and conditions using complete, as-supplied packages representing actual field running conditions. Test boundaries are defined for the air intake system, inlet pressure, relative humidity, inlet temperature, static discharge pressure, discharge temperature, pipe diameters and flow. Measurements of electrical input are made for the drive system (main drive motor, gearbox, variable frequency drive (VFD), electromagnetic compatibility (EMC) filter, harmonics filter, etc., as appropriate) and package auxiliary devices (enclosure ventilation fan, lubrication system, bearing controller, main drive motor cooling system, etc., as appropriate). Since actual test conditions are rarely consistent, BL 5389 specifies required corrections to ensure that test results and guaranteed performance values are comparable, manufacturer to manufacturer and package to package.

The CAGI BL 300 Standard Creates a Level Playing Field for Testing

When blower performance is tested according to ISO 1217 or BL 5389, as appropriate, BL 300 enables the fair comparison of package performance on a level playing field. “BL 300 is a standard means of evaluating of blowers which provides users with complete package performance data that was just not available before,” according to Chris Johnson, Vice President of Thomas Associates, Inc. and Executive Director of CAGI. “It includes a reference to ISO 1217, the standard for testing positive displacement blowers, and to BL 5389, the standard for testing turbo blowers.”

Johnson notes that both turbo blowers and positive displacement blowers may be appropriate to a given wastewater treatment application. “BL 300 includes a section geared toward helping prospective buyers and their technical advisors compare the performance of positive displacement and turbo blowers and interpret test results.”

When blower packages are compared using BL 300, wastewater plant managers, engineers and technical advisors can use CAGI datasheets to access the following performance information:

- **Compressor Data**: This lists manufacturer-provided information such as rated operating pressure, rated capacity at rated operating pressure, drive motor nameplate rating, and compressor rated speed.
- **Performance Table**: A performance table shows delivered airflow for a range of discharge pressures.
- **Package Performance Chart**: This type of chart plots performance curves for specific power across a range of capacities.
- **Test Summary Report**: The test summary report provides a range of as-tested values, specified/guaranteed conditions, data corrected to specified conditions, and a comparison to guarantee.

A consulting engineer can use this information to evaluate whether positive displacement or dynamic blower technology makes better
economic sense given the plant’s process design and the variability of demand for air. This can lead to more confident recommendations.

A wastewater engineer or plant manager can use this information to compare offers from multiple suppliers of blower packages to determine which technology and which proposal meets the project parameters while providing the lowest total cost in the long term.

To aid in the clear interpretation of results, each value listed in the CAGI datasheet includes a reference to the relevant section of the standard.

**CAGI Datasheets on Blower Performance**

John Conover, Business Development Manager, Blowers and Low Pressure Compressors with Atlas Copco, was a member of the CAGI sub-committee that developed the standards. “Blowers can use a lot of power so they should be efficient,” Conover said. “Maybe one machine costs less to buy, but by using the CAGI datasheets buyers can determine which machine has the lower total cost because it is more efficient. Buyers can use that information to work with their utility in determining financial incentives or rebates related to equipment upgrades, which can reduce the cost of investing in greater efficiency.”

Conover believes that there’s more to CAGI datasheets than consistently measured performance data. “A datasheet adds credibility by showing that the manufacturer tested their equipment according to a CAGI standard. It’s a way for a manufacturer to demonstrate that they are a company going to market in a reputable way. I think this fits the mission of all companies that are part of CAGI.”

Positive displacement blowers and turbo blowers use different technologies that can make it difficult to compare the efficiency of machines head-to-head. The new CAGI BL 300 standard enables consulting engineers and prospective customers to evaluate machines that are tested consistently according to their underlying technology and then fairly compare the data that emerges. CAGI data sheets provide consistent, corrected information that enables comparison of blower packages on a level playing field.

There’s no law that requires manufacturers to state blower package performance according to a standard, but CAGI expects market demands for efficiency will lead manufacturers to state low-pressure blower performance according to BL 300. Manufacturers have done this for many years using ISO 1217 with higher-pressure positive displacement equipment, such as rotary screw compressors, and using ISO 5389 for higher-pressure turbo compressor packages. What’s more, CAGI standards can be used by all manufacturers, whether or not they are CAGI members.

“Purchasers and specifiers can help us, responsible manufacturers, and themselves by making informed decisions and using only equipment that is tested to this standard,” said Johnson. “Better yet, ask for CAGI datasheets.”

“As customers’ requirements evolved, manufacturers have extended their product offerings to include a complete blower package,” according to Kenny Reekie, Product Manager, Low Pressure & Vacuum Products for Gardner Denver and Chairman of the CAGI Blower Section. “Test standards that take into consideration all of the additional components in the package now exist to provide a uniform means of measuring overall package performance. These standards are not intended to serve as an application primer that says what you should buy. Instead, they’re about fair, consistent, unbiased information that can be used to make well informed business decisions.”

For more information on the Compressed Air & Gas Institute, please visit www.cagi.org

CAGI standard BL 300 is intended as a guide to aid the manufacturer, the consumer and the general public. The existence of a standard does not in any respect prejudice anyone, whether they have approved the standard or not, from manufacturing, marketing, purchasing or using products, processes or procedures not conforming to the standard. CAGI standards are subject to periodic review and users are cautioned to obtain the latest editions.

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